

## BATTLESPACE TERRAIN REASONING & AWARENESS BATTLE COMMAND (BTRA BC) JOINT-GEOSPATIAL ENTERPRISE SERVICE (J-GES) GAZETTE



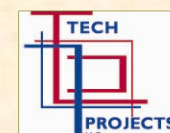
4QY07

### A message from the Program Manager ...

I would like to personally welcome you all to the first edition of *BTRA BC/J-GES Gazette*. The goal of this publication is to provide timely, relevant information on each program and to educate the broader community on our missions. Each quarter, a new edition will be published, covering programmatic goals, accomplishments, lessons-learned, and upcoming events. Our bottom-line is to providing tangible products to the war fighter. I would also like to personally thank Mr. Mike Powers, my predecessor, who provided a great vision and foundation which has directly lead to the many successes of both programs. Best of luck on your new position as the Technical Director of Research!

**Dan Visone, PM BTRA BC/J-GES**

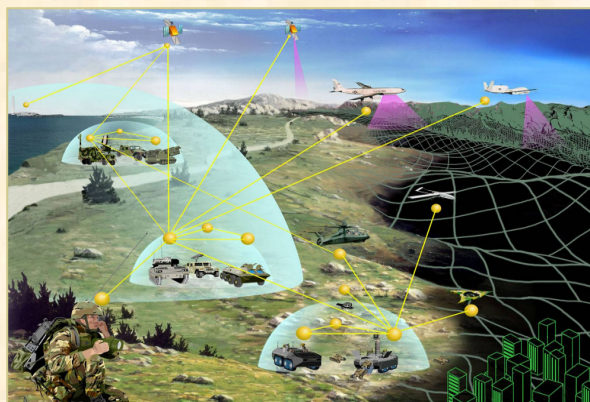
### The Team...



### Battlespace Terrain Reasoning & Awareness - Battle Command

#### Functional Mission:

To increase the effectiveness and agility of Battle Command (BC) and the Military Decision Making Process (MDMP) through the application of geo-environmental data, information and knowledge, across the greatest extent possible across of the force.

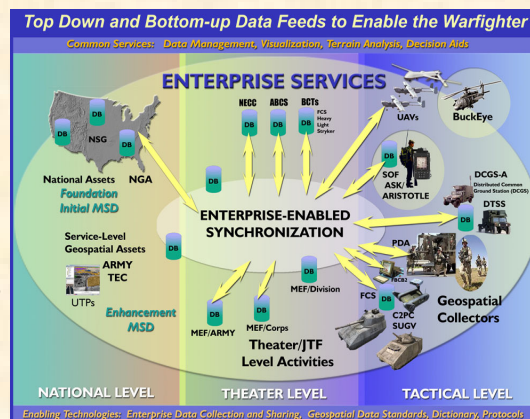


*Continued on page 2*

### Joint - Geospatial Enterprise Service

#### Functional Mission:

Perform research, system engineering and analysis leading to a Geo-Environmental Services based Information Architecture supporting the C4ISR requirements of a net-centric, highly automated and autonomous force, ensuring power to the edge of the force.



*Continued on page 3*

*Government Leads/POCs ...*

## BTRA BC Overview (cont.)

BTRA BC:

Program Manager: Dan Visone  
Daniel.Visone@us.army.mil  
703-428-6920

Technical Lead: Shane McIntyre  
Shane.McIntyre@us.army.mil  
703-428-6038

GeoBML Lead: Harland Yu  
Harland.Yu@us.army.mil  
703-428-6798

Army Research Laboratory (ARL): Don Hoock  
(505) 678-5430  
dhoock@arl.army.mil

Cold Regions Research and Engineering Laboratory (CRREL): Geoff Koenig  
George.G.Koenig@us.army.mil  
603-646-4556

Construction Engineering Research Laboratory (CERL): Kirk McGraw  
Kirk.David.McGraw@us.army.mil  
217-373-3328

Geotechnical and Structures Laboratory  
(GSL): Randy Jones  
Randy.Jones1@us.army.mil  
601-634-4145

J-GES:

Program Manager: Dan Visone  
Daniel.Visone@us.army.mil  
703-428-6920

Deputy / Network Performance:  
Jennifer Hanson  
Jennifer.Hanson@us.army.mil  
703-428-6308

ESRI Reference Implementation:  
Doug Caldwell  
Douglas.R.Caldwell@us.army.mil  
703-428-3594

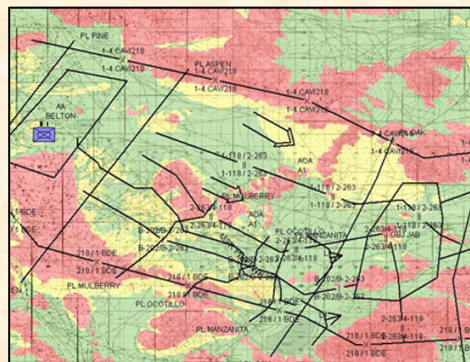
Synchronization/Replication:  
Larry Cook  
Larry.C.Cook@us.army.mil  
703-428-6615

BTRA BC's focus is the development of analytics designed to create information and knowledge products that capture integrated terrain and weather effects and to develop predictive decision tools to exploit those products. The ultimate objective is to empower Commanders, soldiers and systems with information that allows them to understand and incorporate the impacts of terrain and weather on their functional responsibilities and processes.

BTRA BC generates information addressing: 1) Observation, Cover and Concealment, Obstacles and Mobility, Key Terrain and Avenues of Approach (OCOKA), 2) integrated products defining operational Positions of Advantage, 3) high fidelity weather/terrain effects related for mobility and signature physics, 4) advanced mobility analysis, 5) digital ground and air maneuver potential and 6) tactical structures relating information produced by the other components.

Decision tools operate on BTRA BC information products. These tools support: 1) predictive multi-criteria, multi-objective maneuver and logistical route analysis for ground and air platforms and forces, 2) predictive sensor performance (e.g. infrared and acoustic), 3) terrain based Course Of Action evaluation and war gaming and 4) predictive threat assessment.

BTRA BC will continue Research and Development through 2010. Mature BTRA BC components, under funding from the Office of the Secretary of Defense, will transition current and maturing capabilities to National Geospatial-Intelligence Agency's (NGA) Commercial Joint Mapping Toolkit (CJMTK), Digital Topographic Support System, Distributed Common Ground System - Army, and the Future Combat Systems (FCS). Under a Technology Transition Agreement, the Engineer Research and Development center will embark on joint technology development with NGA (CJMTK).



Decision tools operate on BTRA products, not the original data.

*Distinguished Visitors ...***J-GES Overview (cont.)**June 15, 2007**Congressional Staffers:**

Ms. Stacey Dixon  
House Permanent Select Committee on  
Intelligence (HPSCI)

Ms. Jody Houck  
House Permanent Select Committee on  
Intelligence (HPSCI)

Mr. Timothy McClees  
House Armed Services Committee  
(HASC)

Dr. Arun A. Seraphin  
Senate Armed Services Committee  
(SASC)

Ms. Kristine Svinicki  
SASC Emerging Threats and Capabili-  
ties Subcommittee

June 26, 2007**National Geospatial-Intelligence College**

The School for Geospatial-Intelligence  
(TSG)

June 27, 2007**Battle Command**

Colonel Harold Greene  
PM Battle Command

Colonel David Moore  
PM Battle Command

July 23, 2007**Force XXI Battle Command Brigade and Below (FBCB2)**

Michael Kelley  
Deputy TCM PBC

Timothy Cherry  
Liaison to TCM PBC/S2 Engineering  
Services

John (JJ) Fenton  
TCM PBC/S2 Engineering Services

Steven Srolovitz  
S2 Engineering Services

The U.S. Army Engineer Research and Development Center's, Topographic Engineering Center (ERDC-TEC) developed a test bed with a Joint - Geospatial Enterprise Service (J-GES) capability to build a bridge between the warfighter, the command center, and at the national level of the National Geospatial-Intelligence Agency (NGA). The J-GES concept was created to partner with other agencies, private industry and academia to develop and influence geospatial standards, policies and procedures and promote the use of geospatial technologies for data management, collection, exploitation, visualization and dissemination of geospatial data/information from any available national or tactical source. It provides a dynamic, customizable, common operational picture and tactical decision aids to allow rapid analysis and situational awareness based upon the best available information across the network, especially from soldiers on the ground.

The initial technology focus areas for the J-GES program in Spiral One included: soldier as sensor using mobile GIS technology; discovery services using metadata portal concepts; high-resolution sensor exploitation; geo-database synchronization; spatial and temporal link analysis; terrain reasoning services; and 3-D terrain visualization. It leveraged commercial and government off-the-shelf technology. Spiral One demonstrated the vision of net-centric geospatial services for current and future battle command systems to many high-level military decision-makers.

Spiral Two included: integration of the Stryker Brigade database; enhanced data discovery, custom synchronization software, interest management and alert services; a Defense Geospatial Intelligence Network (DGINet) site serving TEC generated data; additional terrain reasoning services; predictive analysis and URBAN services; live feeds for the user-defined operational picture; enhanced data entry; and the use of Buckeye imagery as a valuable resource for mission planning.

Spiral three will focus on:

- Experimenting with ArcGIS 9.2 functionality in support of enterprise GIS at different echelons. Specific functionality will include replication/synchronization, mobile application developer framework, ArcGIS Explorer, file format deployment (file-based Geodatabase, personal ArcSDE), Image Server, Network Analyst, and Tracking Server

*Recent Events ...***BTRA BC:**Engines delivered to CJMTK

Slope/Aspect

Complex

Maneuver Network Generator

Movement Projection

Standard Mobility

Spatial Objects - Obstacles, Concealment, Fields of Fire, Chokepoints

GeoBML

- National Training Center (NTC) Scenario Integration Event #1 - Mar 07

- Technical Integration Event #2 - Apr 07

- Caspian Sea Scenario Integration Event #3 - May 07

**J-GES:**Replication/Synchronization Experiment

Basic Engineer CONOPS Feasibility Experiment - May 07

Experimental Evaluation of Advanced Automated Geospatial Tools Experiment - Value Experiment #1

Evaluated contribution of the Battlefield Terrain Reasoning and Awareness - Battle Command (BTRA-BC) suite of geospatial reasoning tools - Mar 07

*Upcoming Events ...***BTRA BC:**Engines to be delivered to CJMTK

Spatial Objects - Engagement Areas - Fall 07

FASST-C and Sensor Performance Models - Fall 07

GeoBML

Technical Integration Event #4 - 30 Jul-03 Aug

Meeting with NATO at The Hague - 06-07 Sept

GeoBML Conference (tentative) - 18-19 Oct

**J-GES:**Experimental Evaluation of Advanced Automated Geospatial Tools Experiment - Value Experiment #2

Aug 07 BTRA BC tools in the Commander's Support Environment (CSE)

Replication/Synchronization Experiment

Nov 07 Initial Task Automation Experiment

Mobile Application Development Framework (ADF)

Nov 07 Basic Mobile ADF Editing Experiment

Image Server

Nov 07 Buckeye Feasibility Experiment

**J-GES Overview (cont.)**

- Quantifying the value of imagery and geo-information within Battle Command and across the Military Decision Making Process (MDMP)

- Quantifying the architectural and network requirements based on concepts validated in: MDMP experiment(s), JGES Spirals 1 and 2, and operating metrics from BTRA-BC, URBAN, Buckeye and UTP, and other ERDC technologies

The J-GES program will continue to evolve and provide an environment and open architecture. J-GES will:

- Integrate geospatial technologies while supporting research and development efforts
- Identify GES gaps and focus future research efforts to address these gaps
- Support the transition of GES technologies to Programs of Record (POR) and continue support for POR and others on a reimbursable basis
- Integrate, experiment, analyze, evaluate and demonstrate with various Department of Defense research centers, industry and academia GES technologies
- Develop, prototype and evaluate new geospatial concepts and services
- Understand the "goodness" and value of geospatial information and how it affects the Commander's decision making process
- Greatly improve data/information access
- Avoid costs associated with redundant databases
- Foster data reuse

## J-GES Laboratory

The Joint-Geospatial Enterprise Service Laboratory consists of five reconfigurable enclaves to support horizontal, vertical, and peer-to-peer geospatial experiments. Enclaves can be “mixed and matched” to support a variety of customers and experiments from Counter Intelligence/Human Intelligence (CI/HUMINT) to Human Terrain (Cultural) to current Programs of Record (POR) like the Digital Topographic Support System (DTSS). The J-GES laboratory can provide state-of-the-art support to identify operational and technical gaps and solutions with respect to the collection, synchronization, replication, management, dissemination, and exploitation of geospatial data and information.

Current experiments focus in three general areas:

### **Leveraging Industry Technology**

Goal: Understand the operational utility of Commercial-of-the-Shelf (COTS) technology

### **Architecture Insight and Metrics**

Goal: Quantify the architectural and network requirements based on validated concepts using the Shunra/Silk Performer Tools.

### **Data/Information Value**

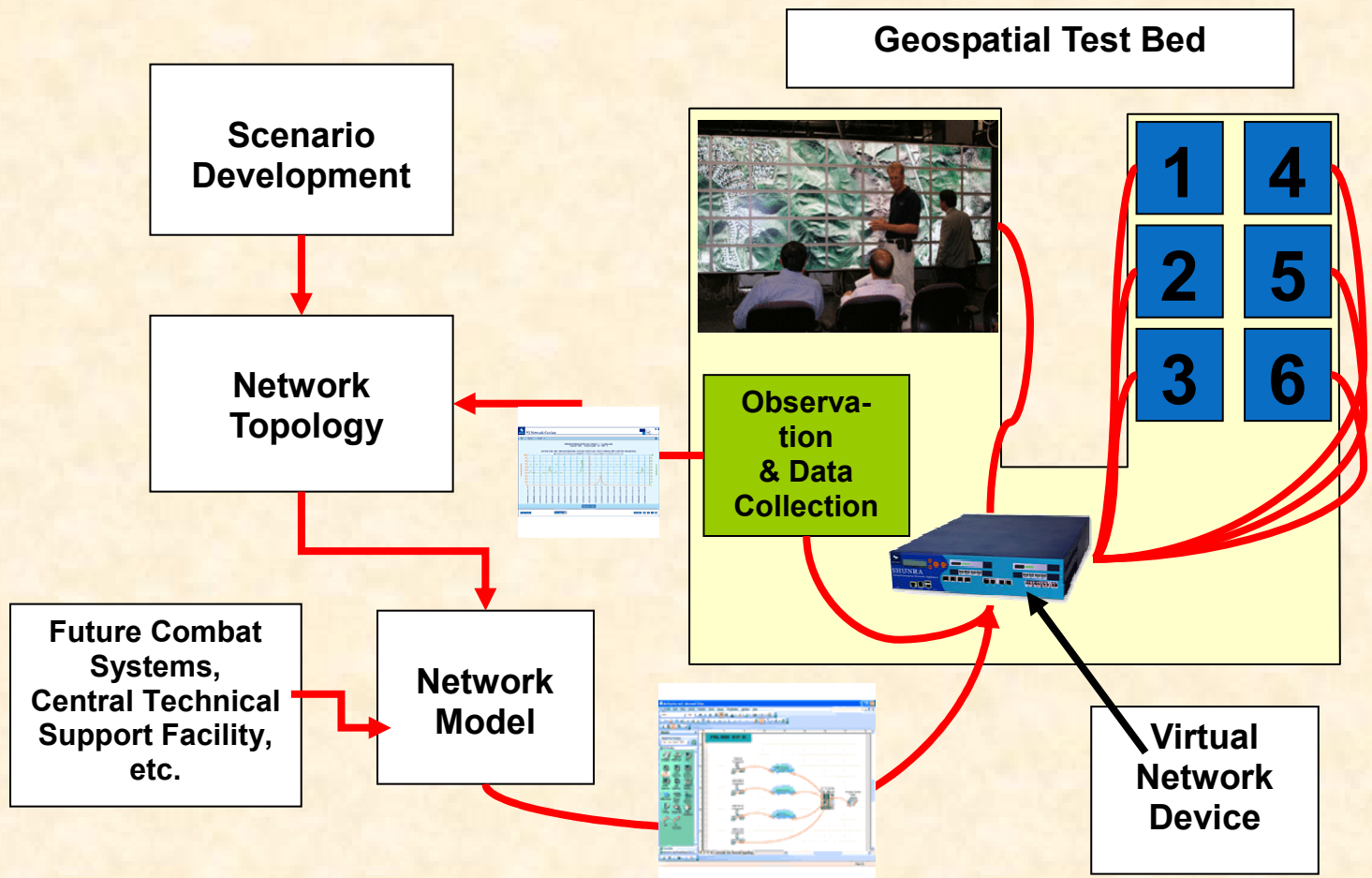
Goal: Quantify the value of imagery and geo-information within Battle Command and across the Military Decision Making Process (MDMP) using the Commanders Support Environment (CSE).

The CSE is a state-of-the-art execution monitoring system designed to monitor and control forward elements of the Objective Force, resulting in reduced staffing requirements. The CSE supports cross-functional, collaborative mission planning and execution monitoring providing a Common Operating Picture (COP) for enhanced, real-time Situational Awareness (SA) in a net-enabled environment. Users have the ability to determine how their products might work in a command and control environment that demonstrates various areas of the Intelligence Preparation of the Battlefield (IPB) process: Intelligence, Command, Fires, Battlespace Manager (maneuver). The CSE will be used to assess the value of geospatial information and analysis in the Military Decision Making Process.



Commander's  
Support  
Environment

## Network Emulation/Performance Testing Tools



Network bandwidth and throughput directly impact the soldier's ability to access and share geospatial information. The use of network analysis software that emulates the networks and performs network analysis will answer key questions of network-related application performance.

Shunra is a commercial software package that emulates networks by simulating packet loss, latency, and bandwidth. Once the software is activated, information may be passed from system to system virtually through the emulated network.

Silk Performer, from Borland, complements the Shunra software and provides extended analysis information on the performance of application in a net-centric environment. With Silk Performer, scripts simulate the use of an application with multiple virtual users. The virtual users can be added 'dynamically', in 'steady state', or 'all day' options.

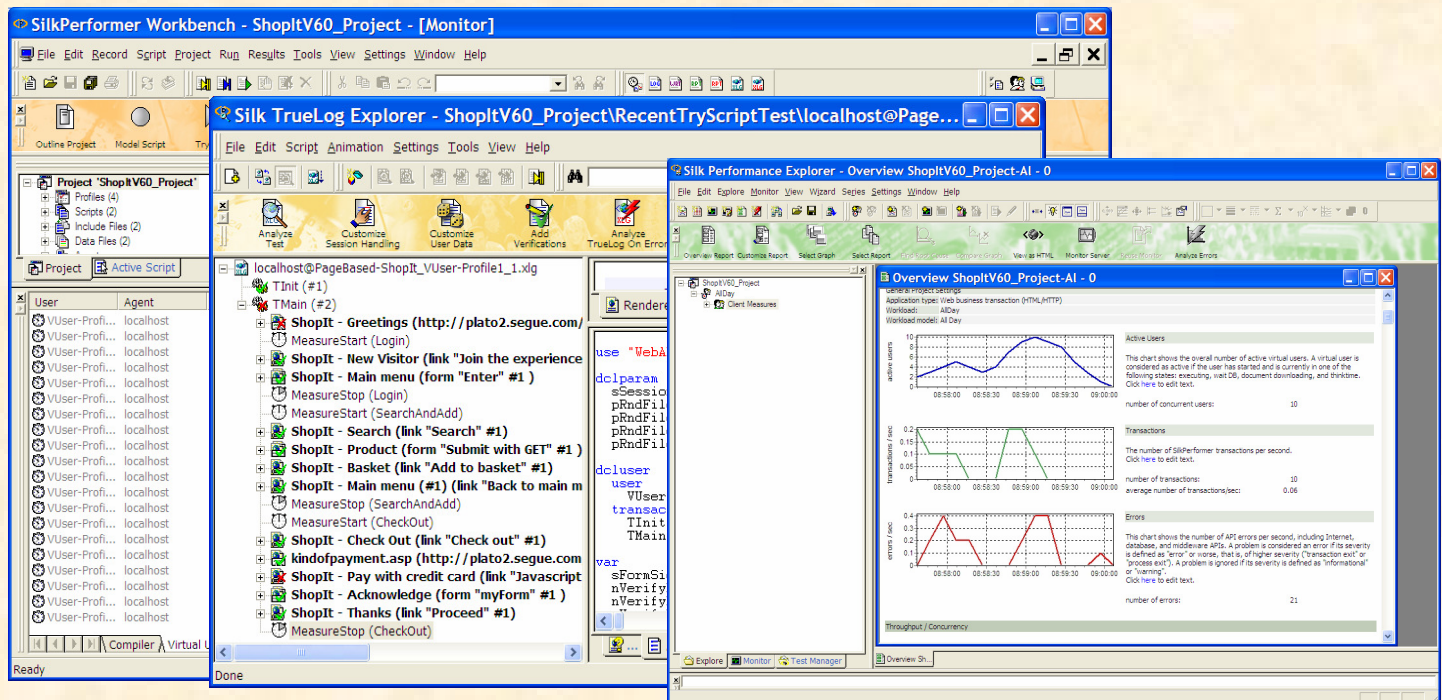
The Shunra and Silk Performer software provide statistics of how an application or web server may perform in the field. The report gives information such as response time per transaction time or per number

## Network Emulation/Performance Testing Tools (cont.)

of users. Users may experience simulated field performance before deploying the application to the field.

This analysis is valuable to Programs of Record (PORs) who are developing web services. The Digital Topographic Support System (DTSS) program has upgraded their Map Server with state-of-the-art web-service technology to provide National Geospatial-Intelligence Agency (NGA) and commercial geospatial data to warfighters, ensuring a common topographic operating environment. Using network diagrams and parameters for Stryker Division, Brigade and Battalion, transaction times and responses will be generated using Shunra. Currently, analysis will compare the performance of the legacy Map Server functionality to the new web services and also investigate the performance of the new technology, through emulation, in support of the expected transactions in a Tactical Operations Center.

An additional effort will use the network emulation/performance testing tools to evaluate the impact of tactical networks on the replication and synchronization of terrain data. This analysis will begin in late Summer 2007.



# J-GES Experiments: Evaluation of Advanced Automated Geospatial Tools Experiment

- **General Purpose:**
  - Assess the value added to Military Decision Making from use of Advanced Automated Geospatial Tools (AAGT)
- **Specific Purpose:**
  - Evaluate contribution of the Battlespace Terrain Reasoning and Awareness – Battle Command (BTRA-BC) suite of geospatial reasoning tools
- **Study Objective**
  - Assess the benefit of BTRA-BC tools to terrain technicians performing terrain analysis
- **Study Method:**
  - Perform experiment to compare performance with and without BTRA-BC
  - Participants were students in Advanced Topographic Analysis Course (ATAC) trained as terrain technicians
  - Participants performed two trials of a military planning task:
    - (1) With BTRA-BC tools
    - (2) With Digital Topographic Support System (DTSS)
- **Study Design**
  - Environment: DTSS with and without added BTRA BC functionality
  - Subjects: 18 Advanced Terrain Analysis Course students (mid-grade military terrain analysts)
  - Within subjects design:
    - Each subject solved problem in both conditions (with and without BTRA)
    - Two near-identical scenarios with similar terrain
    - Design was counterbalanced on scenario order and system order
  - Training was conducted on BTRA-BC (1-2 hours) immediately prior to BTRA-BC trial
- **Experimental Tasks**
  - The evaluation scenario began with analysis of specific terrain and continued to the point of generating potential Avenues of Approach.
  - Specific tasks :
    - Generate Combined Obstacle Overlay (COO) (automated, but different process in the two conditions)
    - Identify Mobility Corridors (MC)
    - Categorize Mobility Corridors by size
    - Group Mobility Corridors to form potential Avenues of Approach
    - Plan routes for 3 types of vehicles
    - Identify Choke Points on Avenues of Approach
    - Calculate travel times
    - Recommend subordinate echelon Areas of Responsibility



## Evaluation of Advanced Automated Geospatial Tools Experiment (cont.)

- Answer questions to assess terrain understanding
- Answer questions to assess subjective experience with system

### • Measures

- Time to complete scenario
- Quality of solutions as judged by expert evaluators
- Scores on a questionnaire evaluating subject's understanding of the problem
- Scores on a questionnaire evaluating subjective perception of BTRA

### • Initial Results: - Time to Solution

Average time to scenario completion

- BTRA: 1.1 hours
- DTSS: 3.1 hours
- >99.99% confidence that average times are different

Learning effect

- Average time to completion on DTSS was shorter for subjects who used BTRA first (3.6 hours vs 2.6 hours)
- >99% confidence that average times are different

### • Hypothesis Tests: Subjective Perception

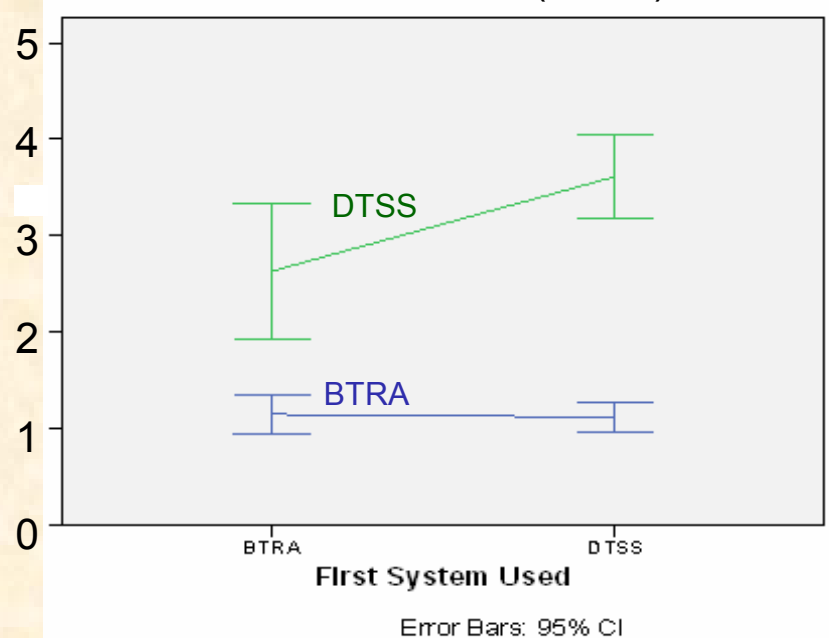
There is strong statistical evidence that:

1. Subjects believe they can produce the required output *more quickly* using DTSS with BTRA-BC:
2. Subjects believe they have *as good an understanding* of the impact of the given terrain on military planning when using BTRA as when using DTSS

### • Preliminary Conclusions

- BTRA-BC dramatically speeds performance on terrain reasoning tasks
- Experience with BTRA-BC may help speed terrain analysis using DTSS
- Terrain technicians believe BTRA-BC speeds performance and improves accuracy without degrading understanding of the terrain

Mean Time to Solution (hours)



# J-GES Experiments - ArcGIS 9.2 Replication/Synchronization Experiment

## Objective:

- To validate US Army Engineer School's (USAES) Concept of Operations (CONOPS) for sharing the Theater Geospatial Database (TGD) at echelons from National to Brigade
- First in a series of experiments

## Focus:

- Validate Concept of Operations
- Assess Basic Architecture Design
- Exercise Out-of-the-Box Functionality
- Evaluate Complexity/Skill Level Requirements

## Scenario:

### Four Echelons

- National (TEC-Operations Division)
- Theater (ESRI)
- Division (TEC-JGES)
- Brigade (USAES, ESRI)

### Operations

- Normal
- Emergency (Information Push)

### Tactical Level TGD

### Connectivity

- Connected
- Disconnected

### Network

- Local Area Network
- Wide Area Network
- ArcGIS Server-Based

## Lessons Learned:

### Notion of Conflict Not Intuitive

- Only a conflict if two edits differ
- No conflict if edit and Default differ

### Part of Editing Workflow

- Need to see differences between edit and Default
- Need to review and accept/reject changes prior to synchronization

### Firewall Issues Limit Server-Based Solutions

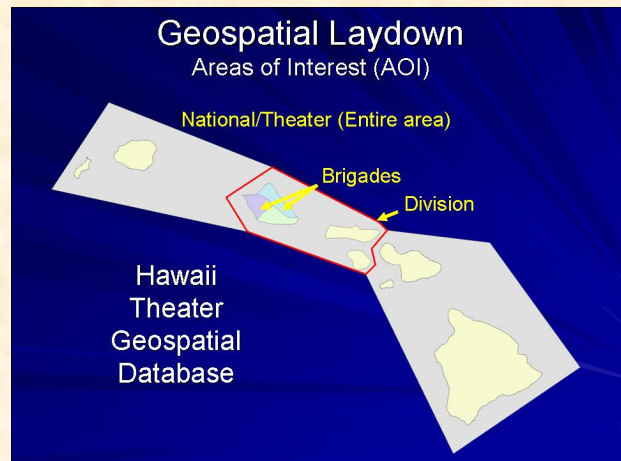
### Management/Setup Fairly Complex

- Many replicas and versions even in simple experiment
- Naming conventions important

### Individual Echelon Operation Manageable, But

- Easy to lose track when working manually
- Complicated to back out when errors made

### Many Opportunities for Automation



## Experiment Tasks

Task ID	Task Name	Description
9	R	T-2a
Theater edits, synchronization, and review		

**Theater action:**  
creates, deletes, modifies features in version posts to default version  
refreshes parent replica versions  
propagates edits - synchronizes with Division and National LERs  
publishes - synchronizes with Division and National LPRs

**Division action:**  
refreshes parent replica versions in LER and LPR  
propagates edits - synchronizes with Brigade LERs  
publishes - synchronizes with Brigade LPR-Div and LPR-THs

**All Unit action:**  
reviews all replicas in map (at each important stage)

**Use Case/Requirements Tracking**

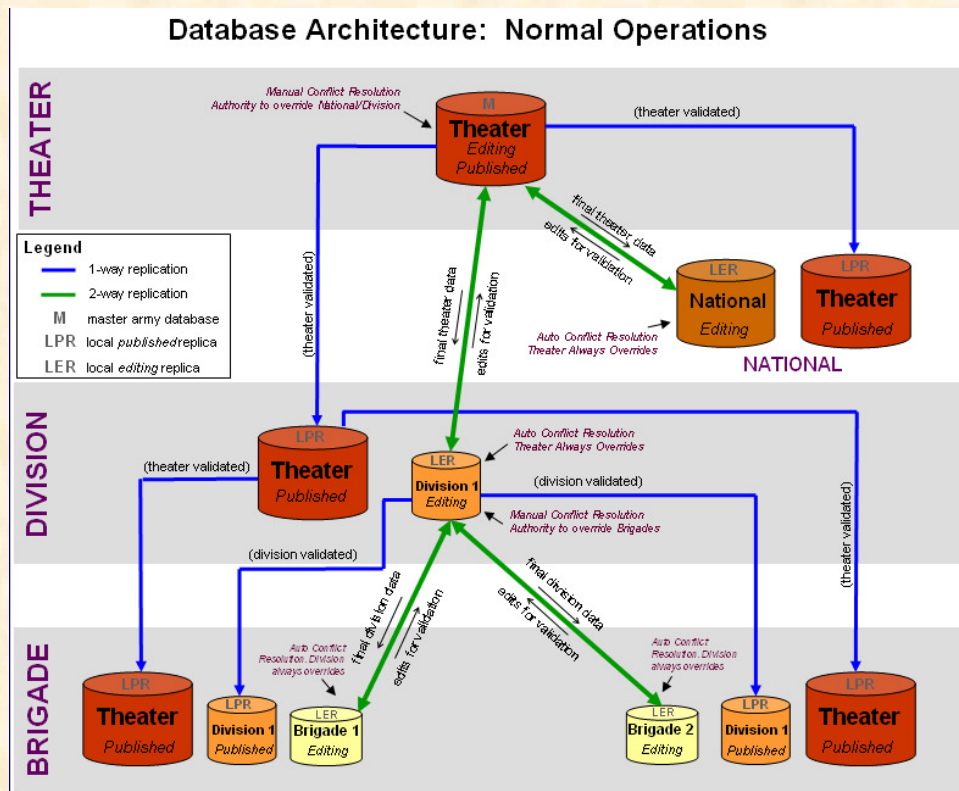
Over 25 tasks defined and tested. Included pre-defined tests and free-form work.

**Graphical Aid for Validation**

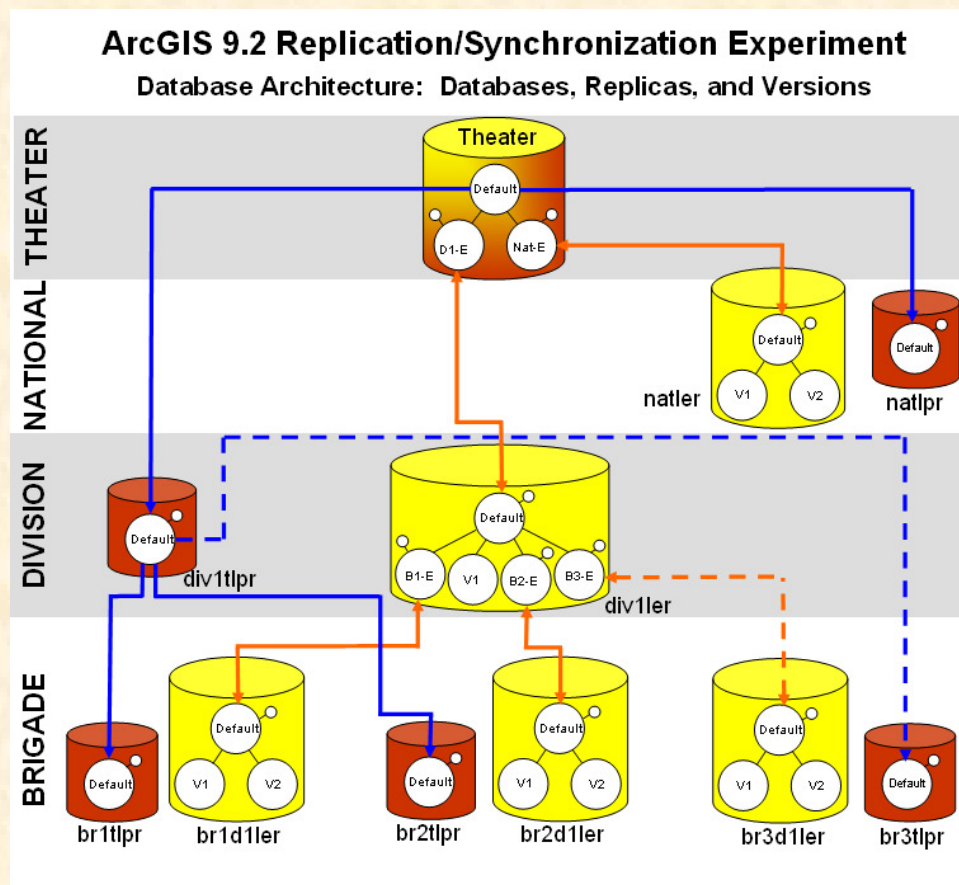


**Replication/Synchronization Works!!!**

# ArcGIS 9.2 Replication/Synchronization Experiment (cont)



Normal  
Operations



Replicas/  
Versions

## ArcGIS 9.2 Replication/Synchronization Experiment (cont)

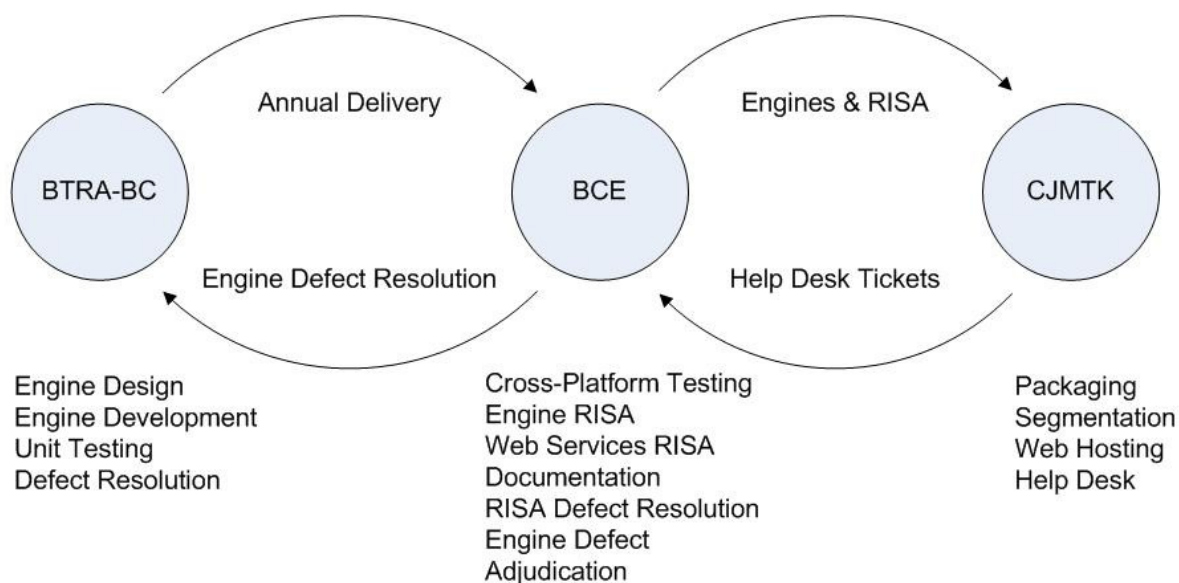
# Conflict Resolution

## Web-Based Editing/ Synchronization

## BTRA-BC CJMTK Extensions (BCE)

- Provides a mechanism to transition capabilities from the BTRA-BC program to the Commercial Joint Mapping ToolKit (CJMTK) program
  - Utilizes CJMTK distribution and support mechanism to deliver to application developers
- Technology Transition Agreement (TTA) between National Geospatial-Intelligence Agency (NGA) and the U.S. Army Topographic Engineering Center (TEC)
  - TTA was signed in April 2006
  - TEC provides Battlespace Terrain Reasoning and Awareness –Battle Command (BTRA-BC) Engines
  - CJMTK distributes BTRA Engines to larger CJMTK community
- BCE will provide maintenance support to the CJMTK Developer Community for the BTRA-BC Engines

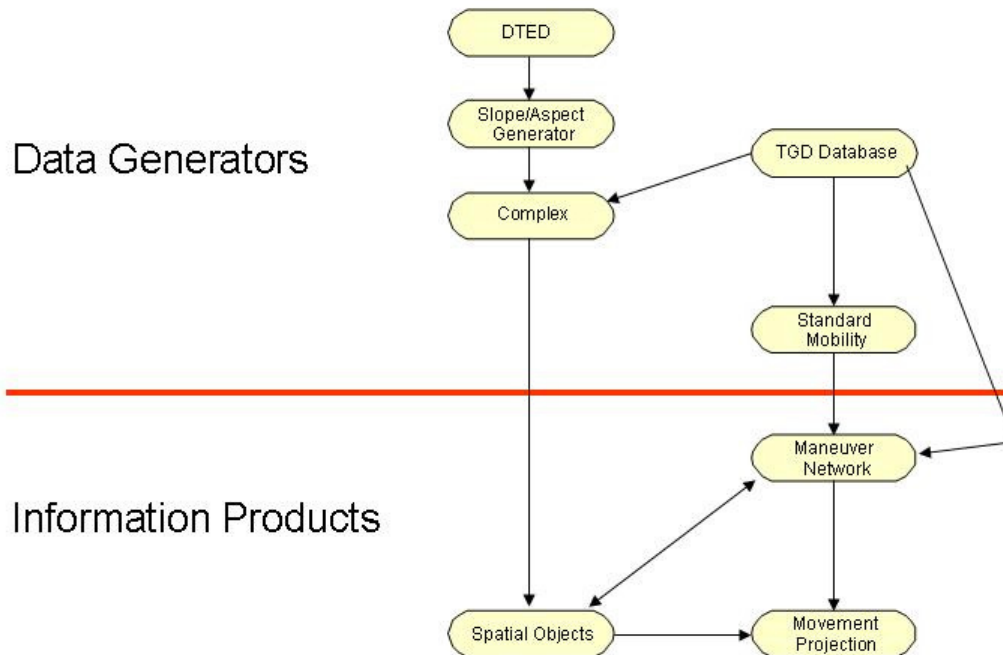
### Program Relationships



## Current BTRA BC Engines

### BTRA-BC Tools (Current Delivery)

---



#### Slope/Aspect Generator

- Creates a polygon feature class using Digital Terrain Elevation Data (DTED) as input and calculates slope, aspect, and mean elevation for each polygon.
- Slope and aspect are grouped into bins that are needed to support the execution of both Standard Mobility (current) and Fast All-Season Soil Strength (FASST)-C (future)
- Results of the slope/aspect generator are an input into the Complex Generator and all values (slope, aspect, and mean elevation) are part of the Complex Generator output

## Current BTRA BC Engines (cont.)

- Current studies being performed to determine if the number of slope/aspect bins can be reduced. Any reductions in the number of bins will reduce the size of the complex

### Complex Generator

- To merge polygonal feature classes from Theater Geospatial Database (TGD) and the results of the slope/aspect generator into a single composite "Complex" feature class
- This product is created for the following reasons:
  - Consistent geometry for information products (sliver removal)
  - Increase the performance of information generators
- The features are combined (unioned) given the following priorities:

- |                                   |                               |
|-----------------------------------|-------------------------------|
| 1. Common Open Water              | 15. Grassland                 |
| 2. Canal                          | 16. Depressions               |
| 3. River/Stream                   | 17. Exposed Bedrock           |
| 4. Island                         | 18. Barren Ground             |
| 5. Built Up Area                  | 19. Vineyards (hops included) |
| 6. Runway                         | 20. Bamboo/Cane               |
| 7. Railroad Yard/Marshalling Yard | 21. Cropland                  |
| 8. Tree                           | 22. Rice field                |
| 9. Orchard/Plantation             | 23. Disturbed Soil            |
| 10. Marsh/Swamp                   | 24. Permanent Snowfield       |
| 11. Land Subject To Inundation    | 25. Ground Surface Element    |
| 12. Scrub/Brush                   | 26. Slope                     |
| 13. Gully/Gorge                   | 27. Aspect                    |
| 14. Dragon Teeth                  |                               |

### Standard Mobility

- Developed by the Geotechnical and Structures Laboratory (GSL) in Vicksburg, MS
- Replacement for the NATO Reference Mobility Model (NRMM)
- User selects a vehicle bin, not a specific vehicle, for the analysis. There are 12 vehicle bins
- Calculates the following speed information based on TGD:
  - Up, down, cross and average speed values for cross-country movement (CCM).
  - Up, down, and average speeds for on-road features (roads, bridges, railroads, tunnels, cart tracks, runways, fords, and ferry crossings)
- The Rating Cone Index (RCI) value from the FASST-C product is an input into the Standard Mobility en-

## Current BTRA BC Engines (cont.)

gine (future). If weather data is not available historical soil strength values are used (current)

### Spatial Objects

- Obstacles - Any obstruction designed or employed to disrupt, fix, turn, or block the movement of an opposing force, and to impose additional losses in personnel, time, and equipment on the opposing force. Obstacles can exist naturally, can be man-made, or can be a combination of both.
  - Determine general obstacles to movement. Not focused on a particular vehicle
- Concealment - The protection from observation or surveillance
  - Determine general concealment score (percentage) and concealment score for each cardinal direction (N, NE, E, SE, S, SW, W, NW) based on vegetation, slope, and aspect
- Fields of Fire - The areas which a weapon or a group of weapons may cover effectively with fire from a given position
  - Inverse of concealment. Will have a general score as well as a score for each of the cardinal directions.
- Choke Points - Geographical locations on land or water that restrict the movement of forces. Can be natural, man-made, or created through the disposition of forces.
  - Finds a primary choke point and secondary choke points that are at a distance based on an echelon's width within a maneuver corridor bounded by two obstacles.
- Engagement Areas - Areas along an enemy Avenue of Approach where the commander intends to contain and destroy an enemy force with the massed fires of all available weapons. The size and shape of the engagement area is determined by the relatively unobstructed intervisibility from the weapon systems in their firing positions and the maximum range of those weapons.
  - Finds engagement areas that are within a specified range of the choke point and have LOS into those areas

### Maneuver Network Generator

- Generates a network containing both on-road and off-road edges that allows single or multiple vehicles to traverse the terrain.
- Network is generated from the following products:
  - TGD
  - Obstacle Spatial Object
  - Concealment Spatial Object
  - Standard Mobility
- Each edge contains the following attributes:
  - Distance

## Current BTRA BC Engines (cont.)

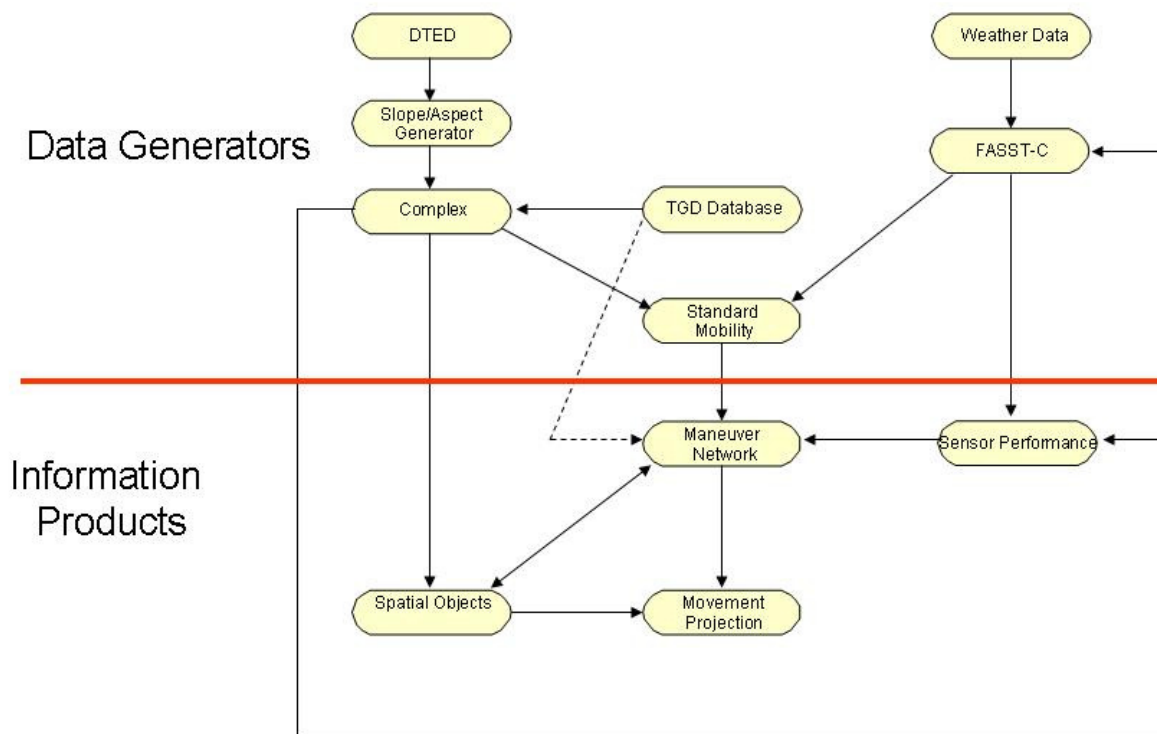
- Width
  - Speed for each of the 12 vehicle classes
  - Concealment
  - Edge Category (obstacle, centerline, connector, road, etc.)
- Used by the Movement Projection tool to calculate different types of routes

### Movement Projection (MP)

- The MP tool has the ability to solve the following types of routes:
- Weighted: Provides the capability to generate the fastest, shortest, or most concealed route given a specified start and stop point.
- Time Constrained: Provides the capability to generate a set of routes that can be traversed before exceeding a specified time or distance.
- Time and Objective: Provides the capability to generate a product that includes all routes that can be traversed if there is a defined objective and a defined constraint (time or distance) to reach the objective.
- Named Area of Interest (NAI): Provides the capability to generate a route and specify what time the force/entity must arrive and leave an NAI in order to arrive at the objective in the specified time.
- Capacity Flow: Provides the capability to generate a set of routes that enables an entity/force to reach a final destination based on the width of the roads and off-road mobility corridors. The capacity specified deals with both frontage and depth.

## Future BTRA BC Engines

### BTRA-BC Tools (Future Delivery)



#### Weather Scheduler/Importer

- Allows users to download current weather data to their system on a set schedule
- Current work being performed
  - Working on retrieving weather data from Air Force Weather Agency (AFWA) using Joint METOC Broker Language (JMBL). Also working with AFWA on another possible solution if JMBL does not satisfy our needs.
  - Currently in discussions with the Integrated Meteorological System (IMETS) program to determine how best to integrate with their system.

#### Fast All-Season Soil Strength (FASST-C)

- Developed by the Cold Regions Research Engineering Lab (CRREL) in Hanover, NH

## Future BTRA BC Engines (cont)

- Predicts the state-of-the-ground based on the terrain, terrain features and the dynamic weather conditions.
- The RCI (rating cone index) value calculated is used in Standard Mobility to calculate on-road and off-road speeds. RCI is a value that represents the soil strength as affected by moisture
- Other weather parameters calculated by FASST-C are used in Sensor Performance calculations

### Sensor Performance

- Developed by Atmospheric and Environmental Research, Inc. (AER)
- Regional Specific Probability of Detection (RSPd): Predicts the performance of infrared (IR) sensors by determining how the sensor is affected by the terrain and the dynamic variation in the state-of-the-terrain as driven by the atmosphere, time of day, time of year, and terrain surface features.
- Acoustic: Predicts the performance of acoustic sensors by determining how the sensor is affected by the terrain and the dynamic variation in the state-of-the terrain as driven by the atmosphere, time of day, time of year, and terrain surface features

### Spatial Objects

- |  |                                |
|--|--------------------------------|
| • Ambush Sites                                   | Assault Positions              |
| • Assembly Areas                                 | Attack by Fire Positions       |
| • Attack Positions                               | Avenues of Approach            |
| • Battle Positions                               | Drop Zones                     |
| • Ground Sensor Locations (Emitting/Receiving)   |                                |
| • Helicopter Landing Zones                       | Indirect Fire Firing Positions |
| • Position Area for Artillery                    | River and Gap Crossing Sites   |
| • Support by Fire Positions                      |                                |
| • Unmanned Aerial Sensor (UAS) Operational Sites |                                |
| • Unmanned Aerial Vehicle (UAV) Routes           |                                |

### Movement Projection

- Suitable Terrain Seeking: Provides the capability to generate a route that is the fastest, shortest, or most concealed from a specified start point to the nearest suitable area. The suitable area is defined from a Position of Advantage (POA) product.
- Force on Force: Provides the capability to generate a set of routes where red and blue forces will meet when they are advancing towards each other.
- Multi-Weight: Provides the capability to generate a route based on a combination of multiple weights (e.g. time, distance, concealment, capacity).

## Geospatial - Battle Management Language (GeoBML)

Geospatial Battle Management Language (GeoBML) enables a more agile and rapid military decision making process for commanders operating in the joint/coalition environment through the use of mission-relevant actionable geospatial information. These geospatial decision aids are standardized according to tactical purpose and military terrain characteristics, created using Battlespace Terrain Reasoning and Awareness Battle Command software, and reused across different domains – Geographic Information Systems (GIS), Modeling and Simulation (M&S), and Command and Control (C2).

GeoBML focuses on three areas:

- Building a cohesive conceptual framework for transforming the copious amount of geospatial data into actionable geospatial information products (termed Tactical Spatial Objects, or TSOs) and links them to military operations.
- Creating pathways for interoperability between GIS, M&S, and C2 systems.
- Leveraging COTS technology and existing open standards, such as Commercial Joint Mapping ToolKit (CJMTK) and the Joint Consultation Command and Control Information Exchange Data Model (JC3IEDM), to implement a reference testbed system.

The conceptual framework consists of the Battle Management Language (BML) itself, High-level Design Documents (HDDs) that outline the military purpose and terrain characteristics of a TSO, and the relationships that link the BML and the TSOs. BML is a formal grammar that can describe a commander's intent (commonly expressed in a military order) with a minimum of ambiguity. A BML-formatted order can be understood either by a soldier or a machine. Because the operational context has been given a high degree of semantic and syntactic precision, the TSOs can be created according to this context and tailored to the tactical tasks that are contained within the order. Each TSO is defined so that it possesses a distinct value within the Military Decision Making Process (MDMP). Its core definition is grounded in military doctrine and can be found within the HDDs. Consequently, we can start to build relationships between the TSOs described in the HDDs and the doctrine-based tactical tasks that a unit must perform in order to accomplish its mission.

GeoBML also provides a way to exchange operational information and associated TSOs between different systems such as M&S and C2 systems. For example, if a Course of Action is outlined within the C2 system, GeoBML can be used to instantiate a simulation for wargaming or mission rehearsal. GeoBML also eases the exchange of information between C2 systems from different echelons or even different countries. These examples illustrate the potential to substantially accelerate the MDMP with GeoBML.

Finally, by leveraging the CJMTK and the JC3IEDM, GeoBML ensures use across our Armed Services and as a link to our coalition partners. CJMTK is the foundation for incorporating geospatial capability into future Army information systems. The JC3IEDM is a product of a 24 nation program to promote interoperability and information exchange between Coalition C2 systems.